The Office of Environment, Safety and Health and its Office of Nuclear and Facility Safety (NFS) publishes the Operating Experience Weekly Summary to promote safety throughout the Department of Energy (DOE) complex by encouraging feedback of operating experience and encouraging the exchange of information among DOE nuclear facilities.

The Weekly Summary should be processed as an external source of lessons-learned information as described in DOE-STD-7501-96, *Development of DOE Lessons Learned Programs*.

To issue the Weekly Summary in a timely manner, the Office of Operating Experience Analysis and Feedback (OEAF) relies on preliminary information such as daily operations reports, notification reports, and, time permitting, conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the summary, please bring this to the attention of Jim Snell, 301-903-4094, or Internet address jim.snell@hq.doe.gov, so we may issue a correction.

Readers are cautioned that review of the Weekly Summary should not be a substitute for a thorough review of the interim and final occurrence reports.

Operating Experience Weekly Summary 97-25

June 13 through June 19, 1997

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EVENTS

1. UNAUTHORIZED MAINTENANCE RESULTS IN PLUTONIUM UPTAKE

On June 11, 1997, at the Los Alamos National Laboratory, a postdoctoral researcher received an uptake of plutonium-239 when he performed unauthorized maintenance on a vacuum valve. The researcher was transferring items from a spool piece to an inerted glovebox when the vacuum valve failed to operate. He noticed the threads on the valve stem were stripped and decided to replace the valve stem. When he removed the stem from the valve body, plutonium became airborne. The researcher removed the valve stem without a radiation work permit or a safe operating procedure, and the area work supervisor was not aware of the work. A radiological control technician surveyed the researcher and detected 2,000 dpm on his face and hair, 500,000 dpm on his chest area, and 5,000 to 7,000 dpm on nasal swipes. Additional surveys indicated 1 million dpm on the valve stem, 2 million dpm in the immediate vicinity of the valve, and 5,000 dpm on the floor below the valve. Continuous air monitor filters indicated airborne radioactivity levels as high as 3,050 dpm/m^3 (1.37 E-9 uCi/ml). Operational medicine group personnel treated the researcher with chelation and placed him on prompt bioassay sampling to calculate a dose. Performing unauthorized work that has not been evaluated for radiological safety hazards can result in internal exposure and the spread of contamination. (ORPS Report ALO-LA-LANL-TA55-1997-0027)

When transferring items, the researcher placed them into a connecting spool piece between a drop box and the inerted glovebox, evacuated the spool piece, and backfilled it with argon gas. At the time of the incident, the spool piece was isolated from the drop box and glovebox. When the researcher could not operate the vacuum valve to evacuate the spool piece, he backfilled the spool piece with argon gas, then removed the valve stem. He took the valve stem to a work bench to remove the O-rings and place them on a spare valve stem. A second worker entered the room, placed some equipment on the work bench, and proceeded to an adjacent room. Seconds later, the worker heard continuous air monitor alarms coming from the room the researcher was working in. He yelled to the researcher that air monitors were alarming in the room. The researcher exited to the adjacent room. He self-monitored with a hand and foot monitor, and it alarmed.

A radiological control technician removed the researcher’s contaminated protective gloves and anti-C coveralls and placed them in a plastic bag. He performed a whole-body survey of the researcher and found no skin contamination other than facial and hair contamination. Nasal smears of the second worker indicated 60 to 90 dpm. He is also on prompt bioassay sampling because of the potential for plutonium uptake. Radiological control technicians taped over the door to the room. They also activated a red light above the room door to inform personnel that hazardous conditions may exist.

Investigators determined that the researcher was aware the valve had a history of problems. They also determined that no one had reported the problem to the maintenance organization so it could be tracked and scheduled for repair. During a critique of the event, the researcher stated that he believed he could take care of the valve problem himself and he never considered the fact that the valve internals or the inside of the evacuation system would be highly contaminated. Laboratory health physicists are continuing to determine the researcher’s exposure. Preliminary estimates indicate a committed effective dose equivalent of 2 to 9 rem.

NFS reported events involving unauthorized maintenance or work in Weekly Summaries 97-10, 97-05, 96-47, 96-43, 96-38, 96-29, 96-25, and 93-06.

- Weekly Summary 97-10 reported that on February 26, 1997, at the Lawrence Berkeley National Laboratory, a researcher spilled a small amount of orthosphosphate P-32 while opening a vial. The work was conducted in a laminar-flow biohood in a laboratory room. Neither the biohood nor the room was authorized for the radioisotope work. The spill resulted in skin, clothing, and internal contamination of the researcher and contamination to the clothing of two other people. Skin and clothing contamination was 150,000 dpm/100 cm^2 and laboratory-area contamination was up to 1,000,000 dpm/100 cm^2. (ORPS Report SAN--LBL-LSD-1997-0002)

- Weekly Summary 96-47 reported that on November 13, 1996, at the Hanford Analytical Laboratory, a diesel mechanic removed a run-hour meter from an operating diesel, causing the diesel and a diesel-operated exhaust fan to stop. The mechanic performed the work without authorization or an approved work package. The diesel-operated fan was running to maintain negative pressure in laboratory hoods to prevent the spread of contamination and possible personnel uptakes. (ORPS Report RL--PHMC-ANALLAB-1996-0004)

These events illustrate the need for workers to be accountable and consider the consequences of performing unauthorized work. Performing work without procedures, radiological work permits, work packages, and authorization places personnel, environment, and equipment at risk. The researcher should have stopped his glovebox transfer and contacted authorities to have qualified personnel safely repair and test the valve. Facility managers should ensure that methods for reporting defective equipment are available to personnel and are used. Personnel should also understand the scope and limits of their work tasks and recognize safety hazard barriers. According to the hazard-barrier matrix in the *Hazard and Barrier Analysis Guide*, developed by the Office of Operating Experience Analysis and Feedback, physical barriers, such as the integrity of the vacuum valve, are the most effective against radioactive material. A copy the *Hazard and Barrier Analysis Guide* is available from Jim Snell, (301) 903-4094, and may also be obtained by contacting the Info Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-72/Suite 100, CXXI/3, Germantown, MD 20874.

DOE/EH-0256T, *Radiological Control Manual*, section 361, “Plutonium Operations,” states that low levels of plutonium in the body are difficult to measure and biological removal processes for plutonium are slow; therefore, primary emphasis must be placed on engineered features to contain plutonium and prevent airborne and surface contamination. Section 361 also references PNL-6534, *Health Physics Manual of Good Practices for Plutonium Facilities*, which provides technical information and day-to-day guidance for managers, health physicists, and others involved in the handling of plutonium. Section 341, “Radiological Work Controls,” states that radiological work activities shall be conducted as specified by the controlling technical work document and radiological work permit. Prerequisite conditions, such as tagouts and system isolation, should be verified in accordance with the technical work documents before work is initiated.

KEYWORDS: internal contamination, airborne radioactivity, contamination, plutonium, valve

FUNCTIONAL AREAS: Radiation Protection

2. CRITICALITY DETECTORS SHIELDED

On June 14, June 10, and June 5, 1997, at Rocky Flats Environmental Technology Site, criticality safety engineers discovered storage room criticality detectors that may not be capable of detecting a minimum criticality accident. During operational safety requirement reviews, criticality safety engineers determined that stored materials are shielding the criticality detectors. The existing analysis considers only permanent features of the buildings (such as walls and tanks) that could block the detectors and does not account for the detectors being blocked by stored materials. Failure to provide adequate criticality monitoring of storage areas could result in a delay in identifying a criticality and eliminates an important personnel safety barrier. (ORPS Reports RFO--KHLL-771OPS-1997-0033, RFO--KHLL-779OPS-1997-0012, and RFO--KHLL-SOLIDWST-1997-0021)

A site contractor identified a concern about material blocking the detectors while performing criticality operational safety requirement reviews. The storage areas are used to store a variety of items including fissile material. The building shift manager terminated nuclear operations in the affected rooms because fissile materials are stored in them. An evaluation is ongoing to determine the amount of fissile material in the affected rooms and develop corrective actions. Each storage area is required to have three detectors available for detection. However, all three do not have to be physically located in one room. Two of these detectors are required for an alarm to activate, and one is required as a backup. Blocking any of the detectors could prevent a criticality alarm.

Operating Experience Analysis and Feedback engineers reviewed the Occurrence Reporting and Processing System database for criticality monitoring deficiencies and found two similar events reported since 1996. These events also occurred at Rocky Flats. Weekly Summary 96-38 reported that one storage room had only one-detector coverage, but the operational safety requirements required three. Weekly Summary 96-30 reported issues regarding analysis of criticality detection and alarm capability for ten storage rooms, where rooms lacked the required detectors and alarms. Facility and criticality safety engineers evaluated these issues and installed additional detection systems to support continued material storage. (ORPS Reports RFO--KHLL-771OPS-1996-0150 and RFO--KHLL-SOLIDWST-1996-0106)

DOE O 5480.24, *Nuclear Criticality Safety*, provides direction on establishing nuclear criticality safety program requirements. The Order invokes several American Nuclear Society Standards for basic elements and control parameters in programs for nuclear criticality safety. ANSI/ANS-8.3, *Criticality Accident Alarm System*, provides direction for establishing and maintaining an alarm system. Section 5.8 of the standard states: "The location and spacing of detectors should be chosen to avoid the effect of shielding by massive equipment or materials."

KEYWORDS: criticality safety, detectors, operational safety requirement violation

FUNCTIONAL AREAS: Nuclear/Criticality Safety, Design, Lessons Learned

3. TWO WORKERS CONTAMINATED AT BROOKHAVEN

On June 9, 1997, the facility manager at the Brookhaven High Flux Beam Reactor reported that an operator and engineer were contaminated while working with dummy fuel elements. Health physics technicians found a cobalt-60 particle with an activity of 11,000 dpm beta-gamma on the operator's work shirt after he alarmed a portal monitor at the fuel vault exit. The technicians surveyed workers who had previously handled the elements and discovered the engineer had a cobalt-60 particle with an activity of 180,000 dpm beta-gamma on the heel of his shoe. The engineer was contaminated while inspecting the fuel elements in a machine shop that was classified as a clean area. The contaminated elements were improperly transported to the clean area because facility personnel bypassed several radiological controls. This resulted in the contamination of the engineer and could have resulted in undetected spread of contamination. (ORPS Report CH-BH-BNL-HFBR-1997-0008)

The operator discovered he was contaminated when he passed through a portal monitor upon leaving the fuel vault. Health physics technicians surveyed two others working in the vault and did not detect contamination. Investigators researched the history of the bagged dummy fuel elements and determined that a supervisor delivered ten of them to the machine shop on June 4. While moving the contaminated material to the clean area, several radiological controls were violated.

- No one tagged the dummy fuel elements as contaminated.
- No one performed the required radiological release surveys when the supervisor removed them from the High Flux Beam Reactor confinement area.
- The supervisor did not request health physics personnel assistance when he alarmed portal monitors while carrying the elements to the machine shop.

Investigators determined that the engineer was exposed to the contamination on June 5 and June 9 when he opened the bags and inspected the elements. They determined that the engineer left the machine shop without passing through a portal monitor because it is not required when leaving the clean area. On June 9, health physics personnel surveyed the engineer, his office, and truck. They detected the cobalt-60 particle embedded in the heel of his right shoe. However, they did not find any other contamination. On the following day, they also surveyed the engineer's home and boat and found no evidence of contamination.

Operating Experience Analysis and Feedback (OEAF) engineers reviewed the Occurrence Reporting and Processing System (ORPS) database for personnel contamination events caused by personnel error and found 820 reports involving 866 occurrences DOE-wide. Over 67 percent of the events occurred during normal operations. Almost 59 percent of the personnel errors were coded as inattention to detail. Figure 3-1 shows the types of activities being performed when individuals were contaminated.

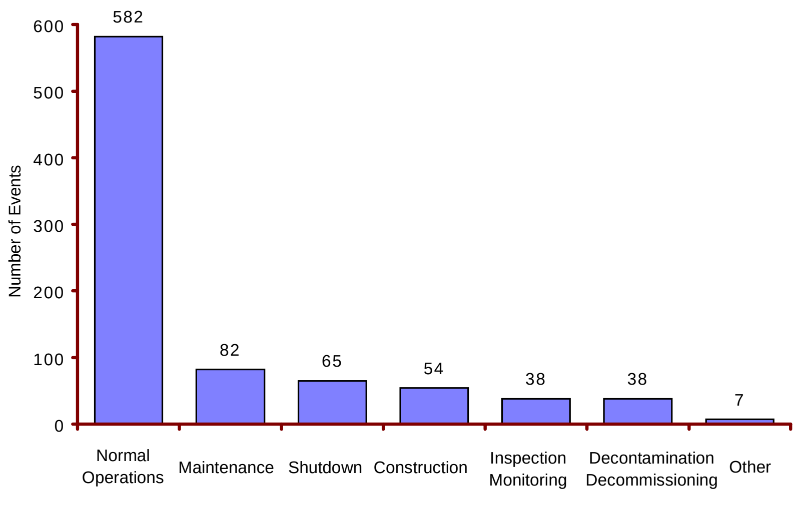

Figure 3-1. Activity Categories For Contamination Events Caused By Human Error[1]

[1] OEAF engineers reviewed the ORPS database for the period 1990 to 1997 AND the nature of occurrence code 4B (personnel contamination) AND the direct cause code 3 (personnel error) and found 820 reports addressing 866 events.

NFS reported related undetected spread of contamination events in OE Weekly Summaries 94-47, 94-17, and 93-11.

- Weekly Summary 94-47 described two undetected spread of contamination events that occurred at the Lawrence Berkeley Laboratory on November 8 and 11, 1994. In both events, individuals carried contamination off-site after leaving with contaminated clothing. The first event involved an individual who spilled radioactive phosphorous-32 on his clothing. The second event involved an individual who traveled off-site with radioactive sulfur-35 on his shoe. The levels of contamination posed no health risks, and no contamination was found off-site. (ORPS Reports SAN LBL-LSD-1994-0004, SAN LBL-LSD-1994-0005)

- Weekly Summary 94-17 reported that on April 22, 1994, a utility operator at the Test Reactor Area of Idaho National Engineering Laboratory found beta/gamma contamination of 3,000 counts per minute on one shoe and 10,000 counts per minute on the other when he was monitored as he left a radiologically contaminated area. Radiological controls technicians confiscated the operator's shoes, resurveyed him with the portal monitor, and found no contamination. They allowed the operator to go home without doing a whole-body survey. Later, they discovered that he had loose-particle contamination on his clothing that was not detected. In order to ensure that contamination had not spread off-site, radiological controls technicians surveyed the operator's house, the bus he had ridden, and the home of another employee. Technicians also surveyed on-site buildings, roads, and grounds that could have been contaminated. No additional contamination was found. (ORPS Report ID--EGG-TRA-1994-0008)

- Weekly Summary 93-11 reported that on March 9, 1993, at Michigan State University, health physics technicians at the Superconducting Cyclotron Laboratory detected carbon-14 contamination outside the radiological control area. They traced the contamination to a radioactive target used by a Lawrence Berkeley Laboratory scientist who visited the university during the week of February 25. Lawrence Berkeley health and safety personnel surveyed the scientist and his personnel effects and found contamination on his shoes, work papers, back seat of his car, a small box, an aluminum target holder, a travel bag, and a sweater. They surveyed his residence and found contamination on clothing and two pieces of luggage. (OEWS 93-11 and ORPS Report ALO-KO-SNL-1000-1995-0001)

These events illustrate the importance of adhering to radiological controls to prevent the undetected spread of contamination. DOE/EH-0256T, *Radiological Control Manual,* provides guidelines to reduce the potential for incidents involving undetected personnel contamination and off-site contamination. Chapter 3 describes proper conduct of radiological work, including contamination control practices and guidelines for monitoring with hand-held survey instruments. NFS published Safety Notice DOE/EH-042, Issue 94-3, "Events Involving Undetected Spread of Contamination," in September 1994. The notice discusses events at DOE and commercial facilities involving the spread of contamination to uncontrolled areas and, in some cases, beyond facility boundaries, because the contamination was not detected at radiological area exits. On March 3, 1994, the NRC issued Information Notice (IN) 94-16, *Recent Events Resulting in Off-site Contaminations*. The notice describes three events that resulted in contamination of individuals and personal property both on and off the licensee's property. DOE 5480.11, *Radiation Protection for Occupational Workers*, established radiation protection standards and program requirements for workers at DOE facilities. This Order has been codified in 10 CFR 835, “Occupational Radiation Exposure.” These incidents could now be considered violations of 10 CFR 835.404, paragraphs (a), (b), (f), and (g), with fines or other civil penalties levied.

Safety Notice 94-3 can be obtained by contacting the Info Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-72/Suite 100, CXXI/3, Germantown, MD 20874.

KEYWORDS: fuel, contaminated, radioactive particle, radiation protection

FUNCTIONAL AREAS: Radiation Protection, Engineering, Operations

4. RAINWATER DAMAGES SAFETY-SIGNIFICANT ALARM PANEL

On January 10, 1997, at the Idaho National Engineering Laboratory New Waste Calcination Facility, a technician discovered that rainwater had leaked into a fire alarm panel, resulting in the failure of interior circuit boards. The fire alarm panel is safety-significant equipment designed to report system trouble to the fire department's alarm room. The technician identified the failure while investigating an audible alarm on another fire alarm panel. During his investigation he determined that the alarm was caused by the control board failures in an associated panel, and a fire did not occur. The technician de-energized the failed fire alarm panel and processed an emergency outage work request to repair the failed circuit boards. Facility management implemented a 2-hour fire watch. Investigators reported that the facility’s roof has been leaking for some time, and repairs were scheduled for later this fiscal year. Rainwater intrusion can damage safety-related equipment, cause false actuation of alarms and safety-related equipment, and result in costly equipment repairs. (ID--LITC-LANDLORD-1997-0008)

Similar events involving degradation of safety-related equipment caused by water intrusion have occurred at DOE and at commercial nuclear facilities. NFS reported water-intrusion events in Weekly Summaries 95-36, 96-24, and 96-39.

- Weekly Summary 95-36 reported that on September 1, 1995, at Rocky Flats, rainwater intrusion resulted in an unreviewed safety question for an emergency diesel generator. (RFO--KHLL-SOLIDWST-1995-0025)

- Weekly Summary 96-24 reported that on June 6, 1996, at Oak Ridge, a 13.8-kv circuit breaker in a substation tripped because 35 gallons of water accumulated in the primary bus compartment of a transformer resulting in a ground fault. Relay targets indicated a phase-to-ground trip on all three phases. Damage to the transformer was minimal; however, power was lost to the High Flux Isotope Reactor, the Radiochemical Engineering Development Center, and ancillary trailers. The power outage caused a reactor scram and evacuation of the Radiochemical Engineering Development Center. (ORO--ORNL-X10PLEQUIP-1996-0007)

- On August 8, 1991, the reactor at a commercial nuclear power station shut down, and safety equipment actuated, when water entered a junction box for a main steam isolation valve. The water entered the building through a defective rain gutter. (Nuclear Regulatory Commission Licensee Event Report 91-017-01)

These events illustrate the importance of routine inspections and preventive maintenance programs. Budgetary reasons for delaying maintenance are not always justified, especially when safety-related equipment can become inoperable as a result.

NFS also reported events in Weekly Summaries 95-28, 94-52, 94-24, 93-45, 93-12, and 93-06 in which water from rain, snow, and pipe leaks entered electrical panels, equipment, and buildings. Problems included false fire and radiation alarms, fires, criticality concerns, motor failures, spread of contamination, and electrical equipment failures. These events illustrate several key lessons. Leaks in building structures or equipment housings that contain safety-related equipment or contaminated material should be repaired quickly to prevent equipment degradation, spurious equipment operation, or spread of contamination. Also, facility managers should verify that equipment is protected from the elements.

DOE-STD-1064-94*, Guideline to Good Practices for Seasonal Facility Preservation at DOE Nuclear Facilities*, provides information for the development and implementation of seasonal weather plans. This standard contains guidance for hurricanes, tornadoes, cold weather, flash floods, and other natural disasters. However, sections of the standard can be applied during periods of heavy rainfall.

DOE-STD-1010-92, *Guide to Good Practices for Incorporating Operating Experiences*, states: "The use of experience gained should provide a positive method that a facility can use to improve their operations, making them efficient, cost-effective, and safe to the employees, the public, and the environment." Managers, supervisors, and operators should review operating experience information and implement it as the standard suggests. Lessons learned are valuable only if the information they communicate is used.

KEYWORDS: rain, water, corrective actions, maintenance

FUNCTIONAL AREAS: Corrective Actions, Lessons Learned, Operating Experience Operations

5. PERSONNEL MONITOR RESULTS INCORRECTLY INTERPRETED

This week Operating Experience Analysis and Feedback engineers reviewed a Los Alamos National Laboratory lessons-learned document describing an April 2, 1997, occurrence at the Plutonium Processing and Handling facility, where a radiological control technician misinterpreted the results from a new whole-body monitor. The monitor detected 20,000 dpm beta contamination on a worker's left forearm, but the technician thought the readout was for his right arm. He used a hand-held instrument to survey the worker's right arm and only detected background radiation levels. The radiological control technician was unfamiliar with the new monitor, which had been installed at the facility for approximately 1 month. Although training sessions had been held to familiarize facility radiological control technicians with the new monitors, the technician had not attended the training because of scheduling conflicts. This event is significant because the technician's lack of training resulted in an undetected source of contamination. (Lessons Learned 1997-LA-LANL-ESH7-0003 and ORPS Report ALO-LA-LANL-TA55-1997-0018)

On April 2, 1997, the worker self-monitored on a newly installed Eberline PCM-2 whole-body monitor. The monitor detected 20,000 dpm on his left forearm. The radiological control technician, who had not received training on the PCM-2, checked the monitor readout and incorrectly interpreted the results as contamination on the right sleeve near the forearm.

However, the readout actually indicated contamination on the worker's left arm. The radiological control technician surveyed the right arm with a hand-held instrument and thought he detected a much lower level of contamination than the PCM-2 results. Because the radiological control technician surveyed the wrong arm, the hand-held monitor detected only background radiation levels. The technician misinterpreted the results as confirmation of the forearm contamination. After his right arm was decontaminated, the worker successfully surveyed out of the facility.

On April 10, the same worker alarmed another PCM-2 monitor. A health physics operations supervisor who had received PCM-2 training responded. He determined that the contamination was on the employee's left arm and instructed him to remove his luminous watch from his left wrist and re-survey. The PCM-2 did not alarm. When the watch was surveyed for loose surface contamination, none was detected. Health physics personnel then analyzed the watch and found it contained promethium-147. The employee was not aware that his watch contained a radioactive substance.

Health physics personnel downloaded the alarm response data from the monitor that alarmed on April 2, and determined that the attending radiological control technician had interpreted the monitor results incorrectly. Because the employee placed his watch in his pocket when his arm was decontaminated, he was able to clear the monitor without alarming it.

The PCM-2 is the first instrument installed at six facility exits that detects alpha and beta/gamma contamination simultaneously. The PCM-2 monitor has multiple detectors on the right and left sides and alternates detector positions halfway through each monitoring cycle. The PCM-2 is also equipped to store data on actuated detector(s), employee identification numbers, date and time of an alarm actuation, and quantity of contamination detected.

Demonstrations of the operating modes and special features of new or upgraded radiological monitoring equipment need to be incorporated into training to ensure that radiological control technicians fully understand the monitoring results. All affected radiological control technicians should receive the training before the equipment is placed in service as part of the facility's formal monitoring program. Training is also necessary for reassigned radiological control technicians if the facility contains monitoring equipment unfamiliar to the technicians. Supervisors should ensure that technicians have received training before they work in areas that include new equipment they will be required to operate. Additionally, survey procedures should include instructions on what action(s) to take if survey data differ significantly between monitoring systems, such as between hand-held instruments and portal monitors.

This lessons-learned notice recommends evaluating radiological control technician training and health physics procedures to determine if monitoring instrumentation issues are adequately addressed. If not, the training or procedures should be revised accordingly. The radiological health and safety policy in DOE/EH-0256T, *Radiological Control Manual*, states that DOE shall ensure personnel responsible for performing radiological work activities are appropriately trained. Standards shall be established to ensure the technical competency of the DOE work force, as appropriate, through implementation of standardized and mandated radiological training and development programs. Section 614, "Qualification Standards for Radiological Control Technicians," and section 641, "Requirements," provides guidance for initial and continuing radiological control technician training.

KEYWORDS: radiation protection, monitor, contamination, training and qualifications

FUNCTIONAL AREAS: Radiation Protection, Training and Qualification

6. OPERATOR VIOLATES CONTAMINATION AREA POSTING

On June 10, 1997, at the Mound plant, an operator in the Tritium Emission Reduction Facility entered a room without authorization that was posted as a contamination area with restricted entry. The operator did not read a radiological area posting that radiological control technicians had changed earlier in the day. The operator was in the room for approximately 5 minutes before a radiological control technician discovered him and had him escorted from the area. The operator was not contaminated. Although radiological control technicians implemented appropriate barriers against room entry, operators have may been complacent towards familiar postings This resulted in the violation of contamination area postings and could have resulted in contamination of the operator. (ORPS Report OH-MB-EGGM-EGGMAT01-1997-0014)

Earlier that day, radiological control technicians discovered approximately 1,400 dpm tritium contamination on the floor of a room in a radiological buffer area. They speculated that the contamination was from a faulty glovebox glove. They changed the radiological posting on the door to the room from "Radiological Buffer Area" to "Contamination Area, Do Not Enter." They also locked the door. A few hours later, an operator unlocked the door with the intent of entering the area. However, a radiological control technician stopped him before he could enter. The operator did not notice that the posting had changed. When he left the area, the operator failed to re-lock the door leaving the radiological posting as the only barrier to entry. Approximately an hour later, a second operator entered the area to validate a procedure. The second operator also failed to notice that the postings for the room had changed. Radiological control technicians determined that the operator was not contaminated and did not receive an uptake.

Investigators determined that the barriers against entry into the room were appropriate, but operators bypassed the barriers because they were not aware of the changing radiological conditions. Operators may have failed to observe changed postings because of a casual attitude toward reading familiar door postings. Facility managers are evaluating the use of additional barriers, including ropes and signs, to inform personnel of recently changed radiological conditions.

NFS reported on a similar event in Weekly Summary 96-25. On June 17, 1996, at the Sandia National Laboratories, a custodial cleaning crew improperly entered and worked in a locked, posted, contaminated area. The room was posted with signs indicating "Controlled Area," "Radioactive Materials Area," "Rad Worker Training Required," and "Tritium." The cleaning crew failed to understand the significance of the sign and obtained entry to the locked room from a security officer. The facility manager instituted corrective actions including (1) counseling the cleaning crew on adherence to postings and restricted access areas; (2) requiring the crew to retake general employee refresher training, including training on postings; and (3) revising security officer training to be more specific on site and job requirements. (ORPS Report ALO-KO-SNL-7000-1996-0002)

These events demonstrate that a casual or inattentive attitude towards posting can lower the margin of safety against increased radiation exposures and contaminations. Entry requirements are posted to ensure that personnel have the proper training, protective and respiratory equipment, dosimetry, and escorts before entering controlled areas.

Failures such as human performance errors can be represented as failed barriers. According to the Operating Experience Analysis and Feedback *Hazard and Barrier Analysis Guide*, barriers provide controls over hazards associated with a job. Barriers may be physical barriers, such as locks or barricade; procedural or administrative barriers; or human action. The reliability of barriers is important in preventing undesirable events such as contamination events. The reliability of a barrier is determined by its ability to resist failure. Postings are designed to improve the reliability of the human action barrier by enhancing human performance. Failure to comply with postings lowers the reliability of the human action barrier and the margin of safety. The *Hazard and Barrier Analysis Guide* provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

DOE/EH-0256T, *Radiological Control Manual*, section 231, "Posting Requirements," states that radiological posting shall be used to alert personnel to the presence of radiation and radioactive material and to aid them in minimizing exposures and preventing the spread of contamination. Section 123, "Worker Responsibilities," states that trained personnel should recognize that their actions directly affect contamination control, personnel radiation exposure, and the overall radiological environment associated with their work. The first rule of worker responsibility is to obey posted, written, and oral radiological control instructions and procedures, including instructions on radiological work permits. Personnel working at DOE facilities should have a continually questioning attitude toward safety issues and area postings. Each individual is ultimately responsible for complying with rules to ensure personal safety. Facility managers should communicate a sound policy stressing that safety is of prime importance and that all personnel must exhibit an individual commitment to excellence and professionalism.

A copy of the *Hazard and Barrier Analysis Guide* is available from Jim Snell, (301) 903-4094. A copy may also be obtained by contacting the Info Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-72/Suite 100, CXXI/3, Germantown, MD 20874. Managers and supervisors should review the guide and incorporate hazard and barrier analyses in work and operation processes.

KEYWORDS: postings, radiological buffer area, radiological work permit, tritium

FUNCTIONAL AREAS: Radiation Protection, Operations